

AMENDMENT UNDER 37 C.F.R. § 1.116
U.S. Appln. No. 09/649,013

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

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1. (Cancelled).
2. (Original): A process for producing an optical wavelength converting device having a periodic domain inversion structure, in which a periodic electrode is formed on one surface of a single-polarized ferroelectric substance having nonlinear optical effects, and an electric field is applied across the ferroelectric substance by the utilization of the periodic electrode in order to set regions of the ferroelectric substance, which stand facing the periodic electrode, as local area limited domain inversion regions, the process comprising the steps of:
- i) forming an electrode material layer on the one surface of the ferroelectric substance,
- ii) forming a photosensitive resist layer on the electrode material layer, the resist layer having properties such that, when light is irradiated to the resist layer, only exposed areas of the resist layer or only unexposed areas of the resist layer become soluble in a developing solvent,
- iii) exposing the resist layer to near field light in a periodic pattern with means, which receives exposure light and produces the near field light in the periodic pattern,
- iv) developing the resist layer, which has been exposed to the near field light, to form a periodic pattern in the resist layer, and
- v) etching the electrode material layer by utilizing the periodic pattern of the resist layer as an etching mask, such that portions of the electrode material layer at positions corresponding

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to opening areas of the mask are removed by the etching, whereby the periodic electrode is formed.

3. (Original): A process for producing an optical wavelength converting device having a periodic domain inversion structure, in which a periodic electrode is formed on one surface of a single-polarized ferroelectric substance having nonlinear optical effects, and an electric field is applied across the ferroelectric substance by the utilization of the periodic electrode in order to set regions of the ferroelectric substance, which stand facing the periodic electrode, as local area limited domain inversion regions, the process comprising the steps of:

- i) forming a first resist layer and a second resist layer in this order on the one surface of the ferroelectric substance, the first resist layer being removable by etching, the second resist layer being photosensitive and having properties such that, when light is irradiated to the second resist layer, only exposed areas of the second resist layer or only unexposed areas of the second resist layer become soluble in a developing solvent,
- ii) exposing the second resist layer to near field light in a periodic pattern with means, which receives exposure light and produces the near field light in the periodic pattern,
- iii) developing the second resist layer, which has been exposed to the near field light, to form a periodic pattern in the second resist layer,
- iv) etching the first resist layer by utilizing the periodic pattern of the second resist layer as an etching mask to form a periodic pattern composed of the first resist layer and the second resist layer, and
- v) forming the periodic electrode on the one surface of the ferroelectric substance by utilizing the periodic pattern, which is composed of the first resist layer and the second resist

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layer, as a mask, the periodic electrode being formed at positions corresponding to opening areas of the mask.

4. (Original): A process for producing an optical wavelength converting device having a periodic domain inversion structure, in which a periodic electrode is formed on one surface of a single-polarized ferroelectric substance having nonlinear optical effects, and an electric field is applied across the ferroelectric substance by the utilization of the periodic electrode in order to set regions of the ferroelectric substance, which stand facing the periodic electrode, as local area limited domain inversion regions, the process comprising the steps of:

- i) forming an electrode material layer on the one surface of the ferroelectric substance,
- ii) forming a first resist layer and a second resist layer in this order on the electrode material layer, the first resist layer being removable by etching, the second resist layer being photosensitive and having properties such that, when light is irradiated to the second resist layer, only exposed areas of the second resist layer or only unexposed areas of the second resist layer become soluble in a developing solvent,
- iii) exposing the second resist layer to near field light in a periodic pattern with means, which receives exposure light and produces the near field light in the periodic pattern,
- iv) developing the second resist layer, which has been exposed to the near field light, to form a periodic pattern in the second resist layer,
- v) etching the first resist layer by utilizing the periodic pattern of the second resist layer as an etching mask to form a periodic pattern composed of the first resist layer and the second resist layer, and

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vi) etching the electrode material layer by utilizing the periodic pattern, which is composed of the first resist layer and the second resist layer, as an etching mask, such that portions of the electrode material layer at positions corresponding to opening areas of the mask are removed by the etching, whereby the periodic electrode is formed.

5. (Original): A process as defined in Claim 3 or 4 wherein the second resist layer has a film thickness of at most 100nm.

6. (Original): A process as defined in Claim 3 or 4 wherein the first resist layer is formed from a non-photosensitive material, and the etching performed for the first resist layer is dry etching.

7. (Currently Amended): A process as defined in Claim [[1,]] 2 3, or 4 wherein the exposure light has a wavelength falling within the range of 250nm to 450nm.

8. (CurrentlyAmended): A process as defined in Claim [[1,]] 2, 3, or 4 wherein the means, which receives the exposure light and produces the near field light in the periodic pattern, is a mask comprising a light-transmitting member, which is capable of transmitting the exposure light, and a metal pattern, which has opening areas and is formed on the light-transmitting member, the near field light being radiated out from the metal pattern, and

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the mask comprising the light-transmitting member and the metal pattern is located such that the metal pattern is in close contact with the resist layer, which is laid bare on the ferroelectric substance, or the metal pattern is located close to the resist layer, which is laid bare on the ferroelectric substance, such that the near field light reaches the resist layer, which is laid bare on the ferroelectric substance, the exposure light being irradiated to the mask comprising the light-transmitting member and the metal pattern in this state.

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9. (Currently Amended): A process as defined in Claim [[1,]] 2, 3, or 4 wherein the means, which receives the exposure light and produces the near field light in the periodic pattern, is an optical stamp constituted of a light-transmitting member, which is capable of transmitting the exposure light and has a concavity-convexity pattern formed on one surface, the optical stamp operating such that, when the exposure light is guided from within the light-transmitting member to the one surface of the light-transmitting member and is caused to undergo total reflection, the near field light in a pattern in accordance with the concavity-convexity pattern formed on the one surface of the light-transmitting member is radiated out, and

the optical stamp is located such that the one surface of the optical stamp provided with the concavity-convexity pattern is in close contact with the resist layer, which is laid bare on the ferroelectric substance, or the one surface of the optical stamp provided with the concavity-convexity pattern is located close to the resist layer, which is laid bare on the ferroelectric substance, such that the near field light reaches the resist layer, which is laid bare on the ferroelectric substance, the exposure light being irradiated to the optical stamp in this state.

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10. (Currently Amended): A process as defined in Claim [[1,]] 2, 3, or 4 wherein the means, which receives the exposure light and produces the near field light in the periodic pattern, is a probe provided with an opening having a diameter shorter than a wavelength of the exposure light, the probe being caused to scan on the resist layer, which is laid bare on the ferroelectric substance, the exposure light being irradiated in this state.

11. (Currently Amended): A process as defined in Claim [[1,]] 2, 3, or 4 wherein the ferroelectric substance is LiNbO₃ doped with MgO.

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12. (Original): A process as defined in Claim 11 wherein the periodic electrode has an electrode line width of at most $0.3\mu\text{m}$.

13-18. (Cancelled).

19. (Currently Amended): The method according to any one of claims [[1-4]] 2-4, wherein a ratio (A/Λ) of an electrode line width of said periodic electrode (A) and a period of inversion regions of the periodic domain inversion structure (Λ) is less than 0.15.

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Count 20. (Currently Amended): The method according to any one of claims [[1-4]] 2-4, wherein a period of inversion regions of the periodic domain inversion structure falls in a range between approximately 1.0 – 4.6 micrometers.

21. (Currently Amended): The method according to any one of claims [[1-4]] 2-4, further comprising subjecting ferroelectric substance having the periodic electrode formed thereon to an electric field to form said periodic domain inversion structure.